NASA TECH BRIEF

Ames Research Center

Computer Program for Predicting Symmetric Jet Mixing of Compressible Flow in Jets

It has been demonstrated that integral methods are capable of predicting symmetric jet mixing of compressible flow in jets, but a finite-difference method is more useful inasmuch as it provides greater flexibility in allowable flow inlet conditions and wall boundary conditions (e.g., the use of wall jets or wall suction). Additionally, a finite-difference method offers the considerable advantage of mathematical precision in determining the overall consequences of any particular hypothesis regarding shear stress distribution.

A finite-difference computer program has been developed for treating the mixing of two parallel and compressible air streams; one of them may be supersonic. In all instances, nozzle expansion is assumed "correct," that is, nozzle exit-plane pressure is matched to the ambient pressure at that station. Thus, expansion waves and shocks at the nozzle exit-plane are assumed to be absent. Even though the correct expansion assumption may not be realized in a practical case, the downstream flow field will not likely be sensitive to small degrees of over- or under-expansion. The flows considered include compound flows of supersonic and subsonic streams; however, no provision is made for the compound choking which may occur with an appropriate transverse distribution of Mach number. Such a condition is amenable to analytical treatment under simplified circumstances, but has not been encountered thus far in experimental tests.

This development is restricted to symmetric jet mixing in which the high-speed jet is located on the axis of the channel and no provision is made for blowing or suction along the channel walls. The variation in channel geometry along the axis is assumed gradual, so that wall curvature is neglected; the pressure is assumed uniform on all planes normal to the axis.

Included in the report on the computer program are: the basic fluid dynamic equations, the derivation of the finite-difference form of the basic equations, the program listing, the program flow chart, the program operation, and the experimental verification.

Notes:

1. The following documentation may be obtained from:
   National Technical Information Service
   Springfield, Virginia 22151
   Single document price $3.00
   (or microfiche $0.95)

   Reference: NASA CR-2251, Analysis and Testing of Two-Dimensional Slot Nozzle Ejectors with Variable Area Mixing Sections.

2. No additional documentation is available. Specific questions, however, may be directed to:
   Technology Utilization Officer
   Ames Research Center
   Moffett Field, California 94035
   Reference: B73-10263

Source: Gerald B. Gilbert of
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